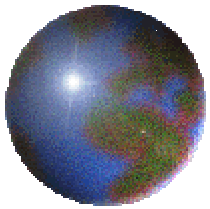

Model Predictions of Nearshore Processes near Complex Bathymetry

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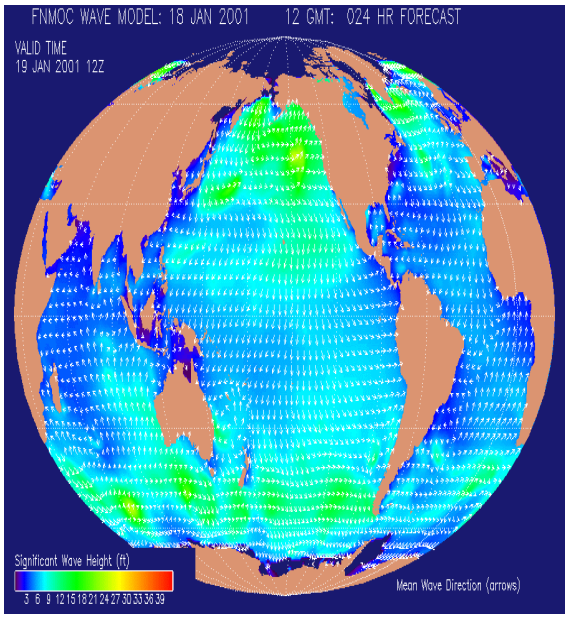
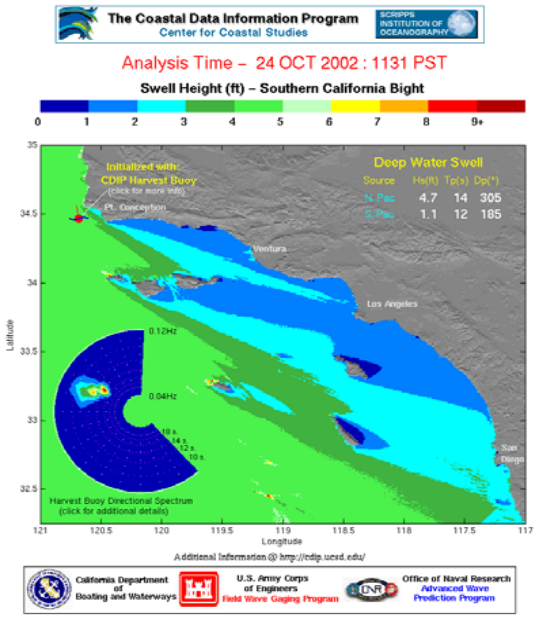
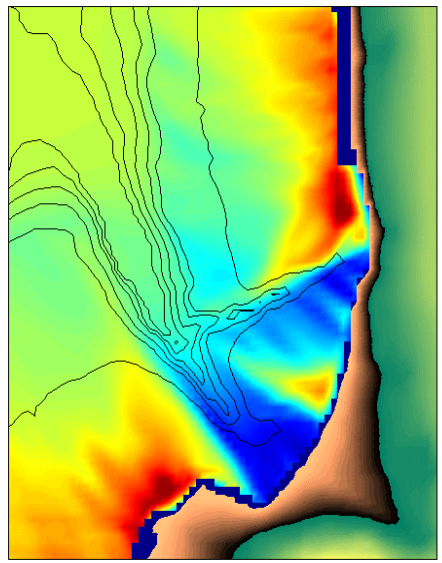
Nature of Wave Modeling



Global wave height forecast from FNMOC

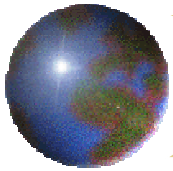


Regional swell wave heights in Southern California Bight from CDIP model



SWAN–X : narrow, 17s swell spectrum from 295°

Local swell wave heights over Scripps Canyon



Wave Modeling and Phenomena

Global

- Wind wave generation
- Whitecapping dissipation
- Deep water nonlinearity
- Bottom friction in shallow areas
- Island shadowing

Regional

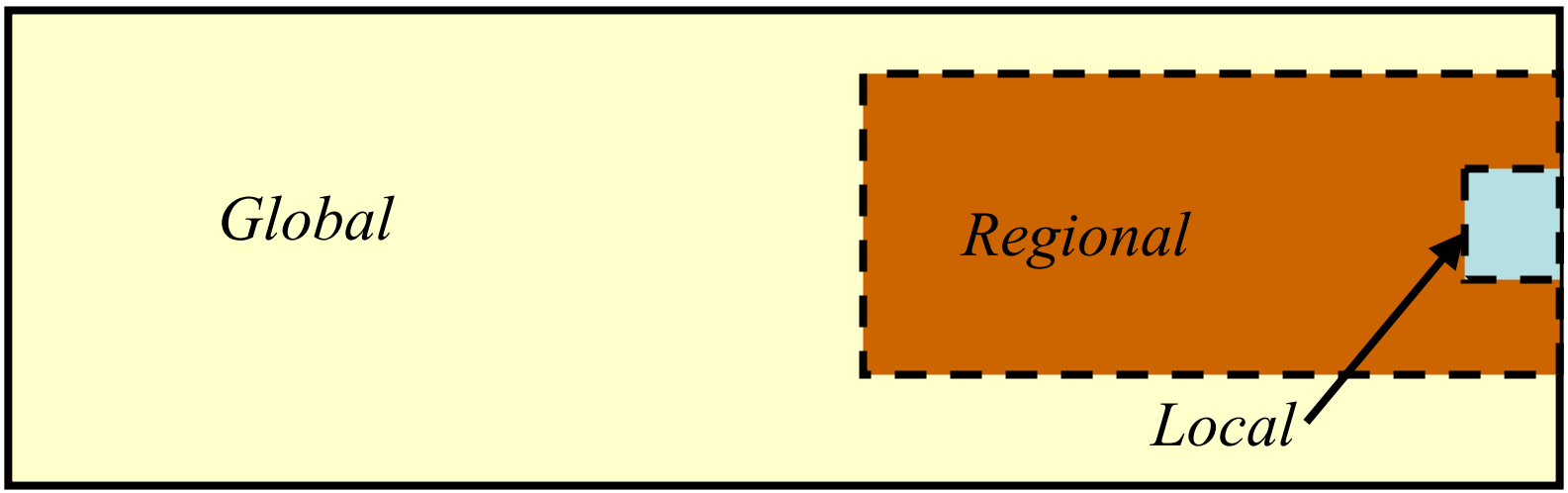
- Refraction and shoaling
- Bottom friction
- Wind wave generation
- Depth-limited breaking
- Whitecapping dissipation
- Deep water nonlinearity

Local

- Refraction and shoaling
- Diffraction
- Depth-limited breaking
- Shallow water nonlinearity
- Bottom friction
- Wave-current interaction

Dependent on wave phase

Models and Nesting



Global

- WAM, WAVEWATCH
- Typical resolution 1 deg.

Regional

- SWAN
- Typical resolution ~ 100 meters

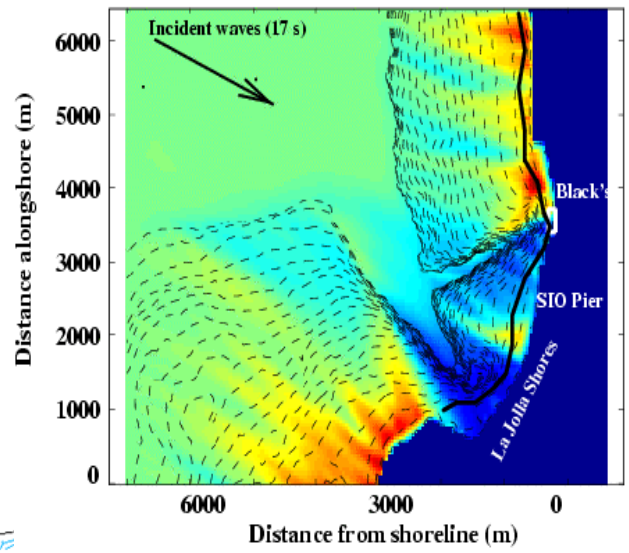
Local

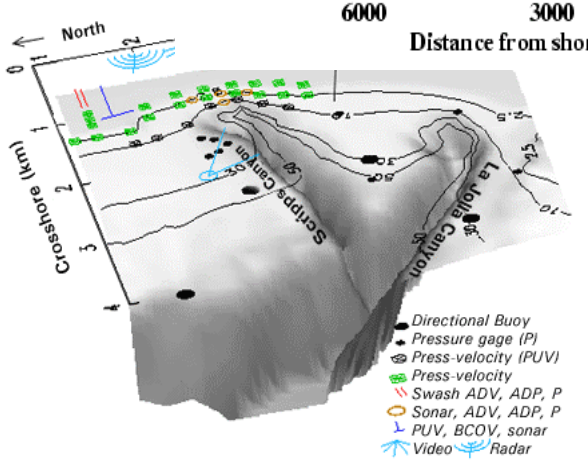
- REF/DIF1, REF/DIF-S
- Typical resolution *O*(10's of meters)

Nearshore Canyon Experiment (NCEX)

- Site located near Scripps Institution of Oceanography
- Slated for Fall 2003
- Swell waves from north dominant at time of experiment
- Area marked by complex bathymetry
- In situ and remotely sensed measurements

SWAN model results over NCEX bathymetry





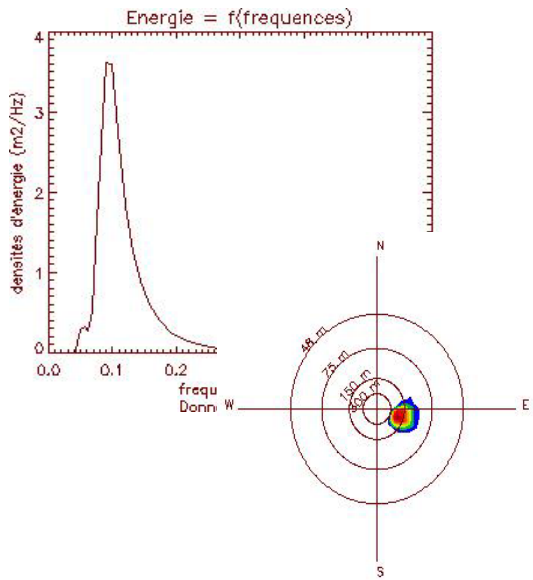
Draft sensor location plan

Initial Conditions for Wave Modeling

CDIP Directional Buoy

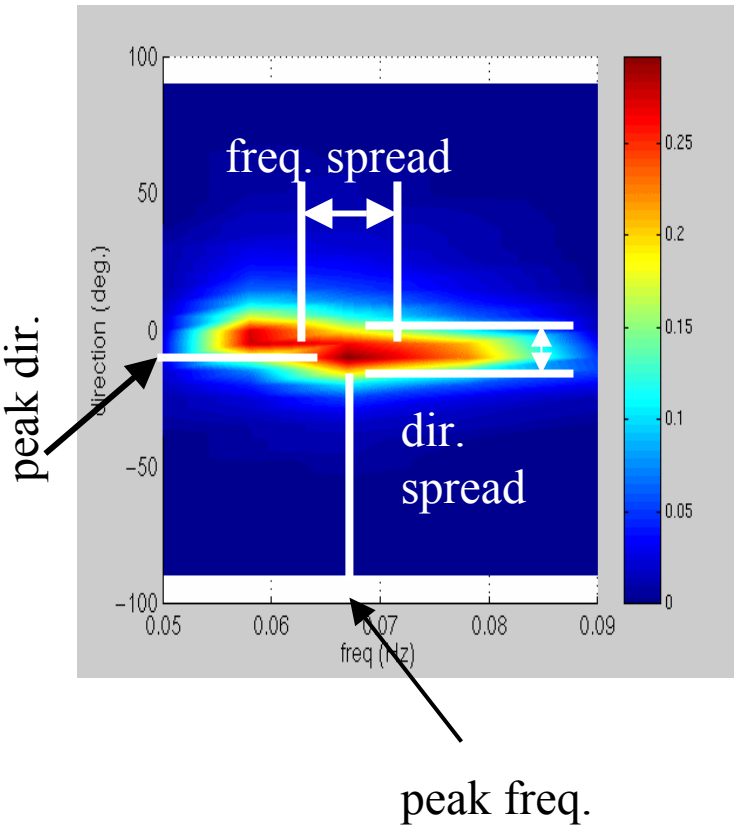
- 0.01 *Hz* frequency resolution
- 5 degree direction resolution
- Available every 30 min.

WAM Forecasts



- Logarithmic frequency binning
- 15 degree direction resolution
- Forecasts available every 6 hours.

Sensitivity to Errors in Estimates of Offshore Spectral Parameters

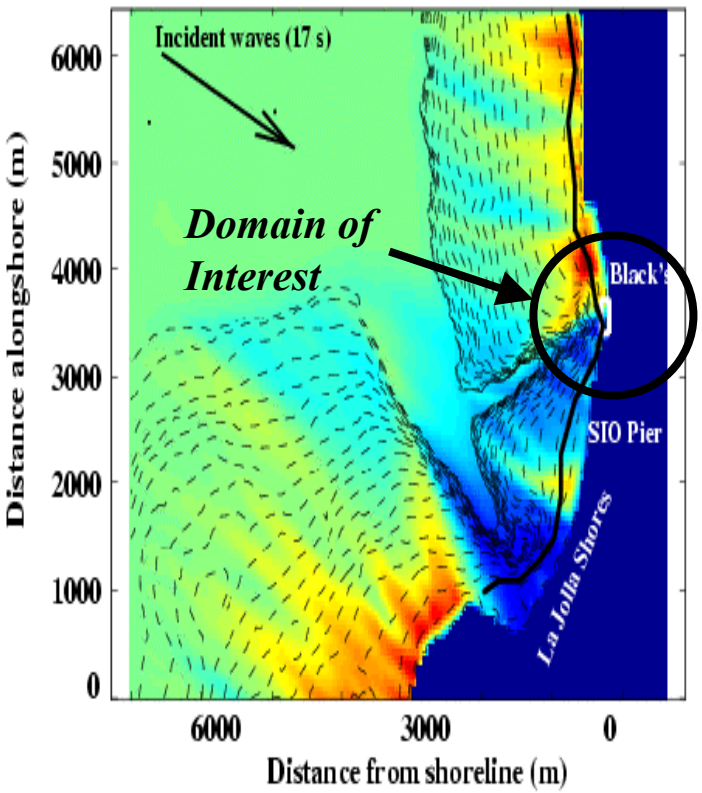


Spectral parameters

- Significant wave height
- Peak direction
- Peak period
- Frequency spread
- Directional spread

Investigate variations in nearshore waveheights with respect to small variations in parameters

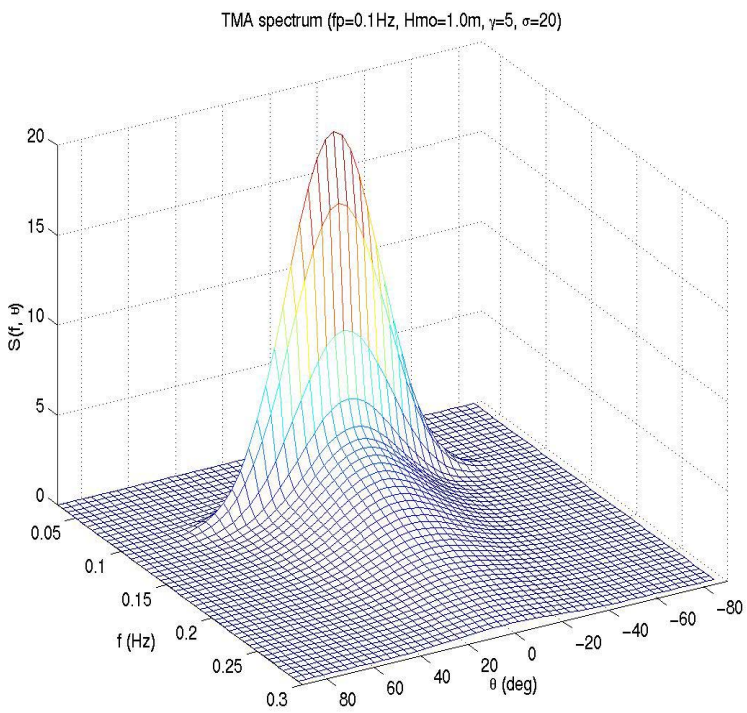
Sensitivity to Errors in Estimates of Offshore Spectral Parameters



Methodology for Sensitivity Testing

- Use SWAN to propagate waves over NCEX bathymetry
- Use parameterized spectra (JONSWAP spectra with cosine directional distribution) for input conditions
- Vary offshore parameters slightly
- Calculate percent difference in waveheight between runs using varied parameters

Sensitivity to Errors in Estimates of Offshore Spectral Parameters



Assumed offshore wave parameters:

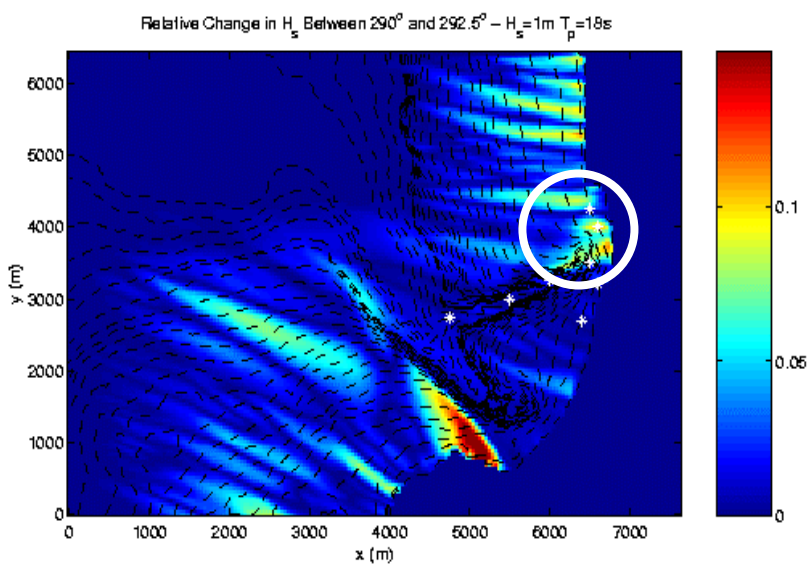
- Sig. height: 1*m*
- Direction: 290 deg. (20 deg. north of west)
- Peak period: 18*s*
- Freq. spread: γ=20
- Dir. spread: σ=5 deg.

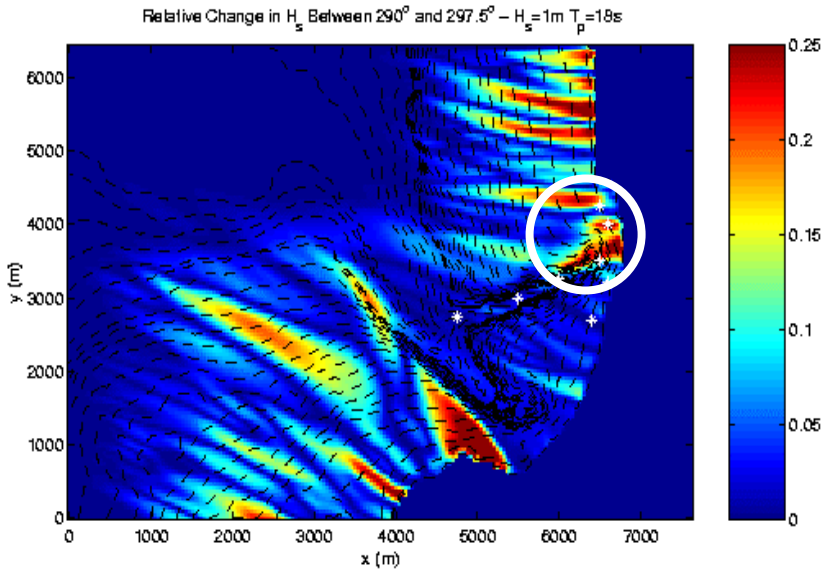
Sensitivity to Errors in Estimates of Offshore Spectral Parameters

Varying the Peak Direction of the Offshore Spectrum:

- Buoy data: directional resolution of 5 degrees implies an uncertainty of ± 2.5 degrees from the reported peak direction
- Model forecast: directional resolution of 15 degrees implies an uncertainty of ± 7.5 degrees from the reported peak direction
- Variation in the nearshore waveheight implies potential error due to chosen directional resolution

Sensitivity to Errors in Estimates of Offshore Spectral Parameters





Potential Error using Buoy Data Directional Discretization

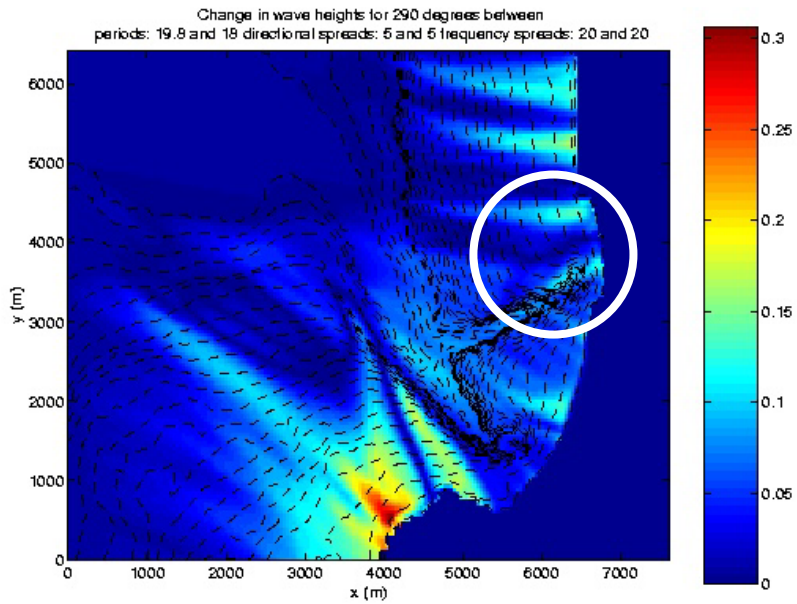
- *Max. variation in area of interest ~9%*

Potential Error using Forecast Model Directional Discretization

- *Max. variation in area of interest ~ 25%*

Sensitivity to Errors in Estimates of Offshore Spectral Parameters

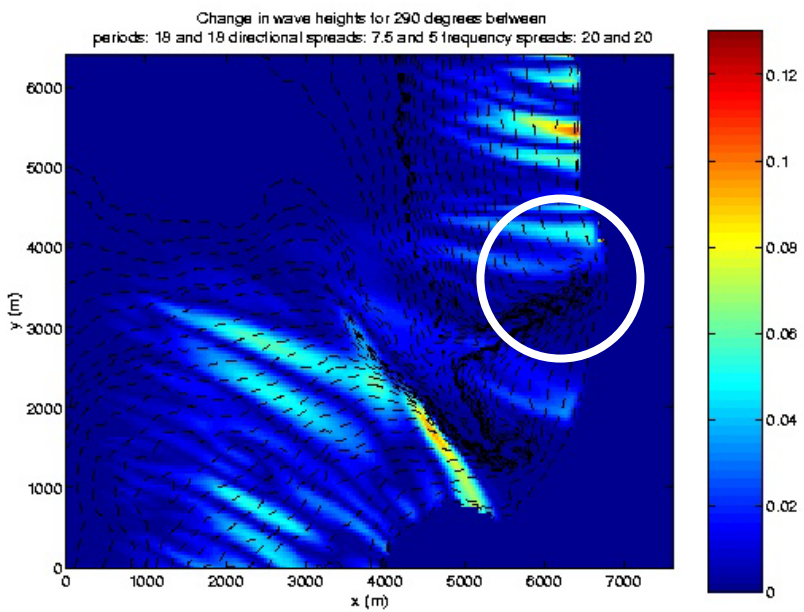
Variation in peak period of offshore spectrum - ±0.005Hz:



- Simulate uncertainty seen in buoy data
- Maximum potential error in nearshore ~12% in area of interest
- Small error in peak period not critical for long period swell

Sensitivity to Errors in Estimates of Offshore Spectral Parameters

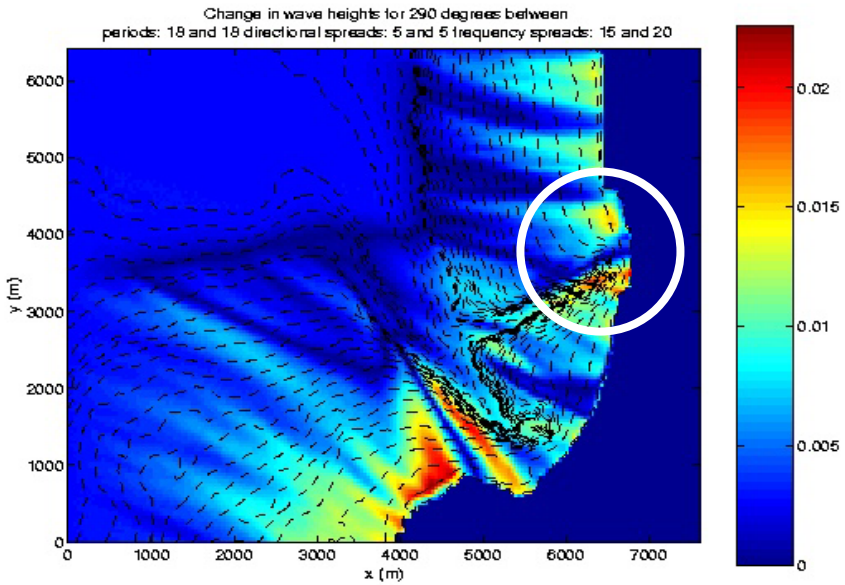
Variation in directional spread (σ=5 deg. – 7.5 deg.)



- Simulate potential error in estimating directional spreading tendencies from buoy data
- Maximum variation in area of interest ~5%.

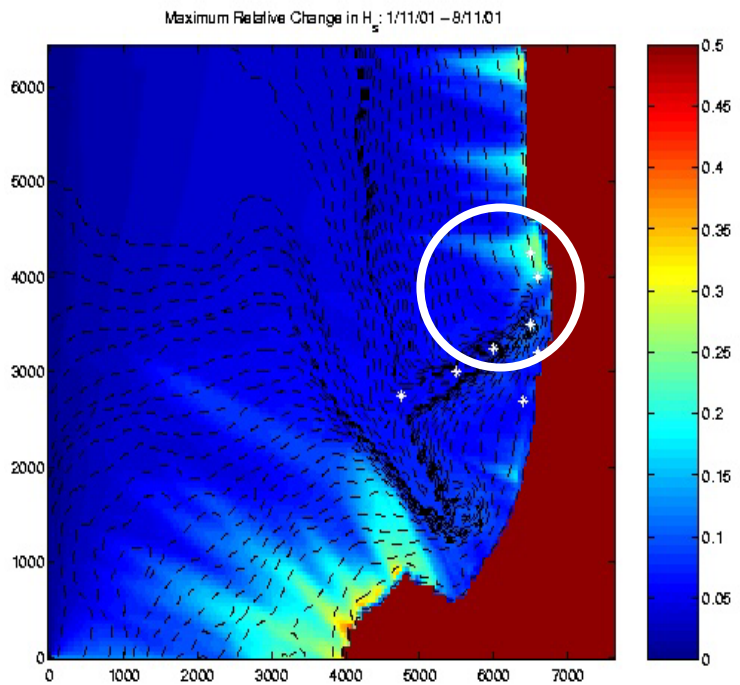
Sensitivity to Errors in Estimates of Offshore Spectral Parameters

Variation in frequency spread: γ=15 - 20



- Errors in frequency spread less likely to occur than in direction spread
- Maximum variation in region of interest ~ 2%

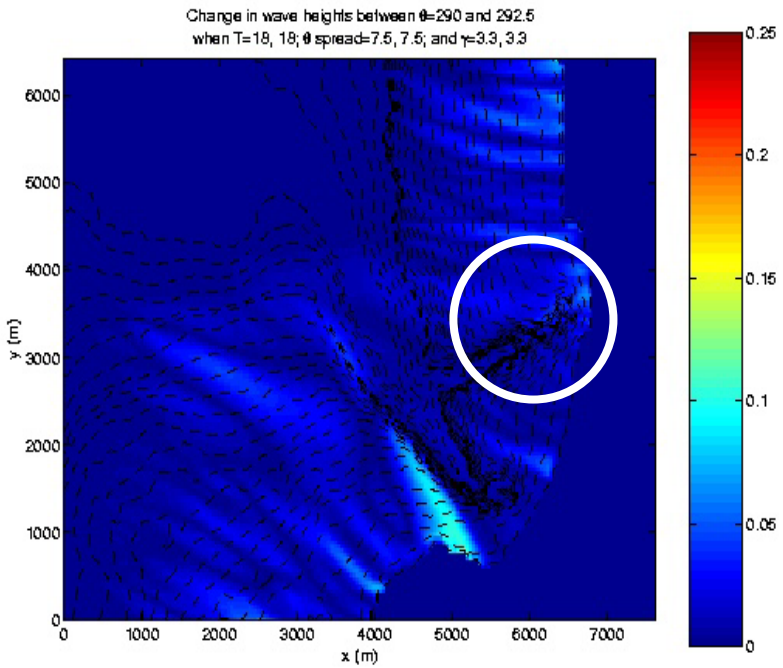
Variability of Nearshore Wavefield: 1-8 November 2001



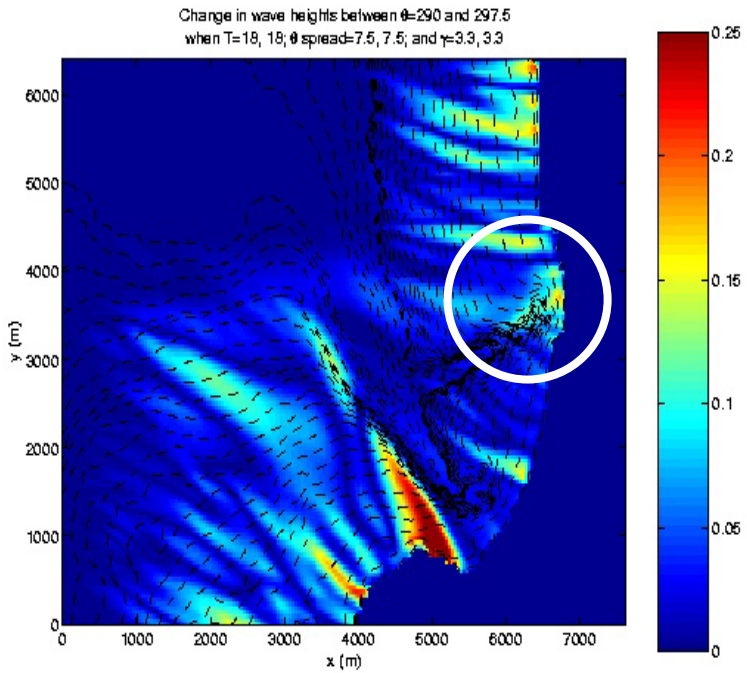
Maximum normalized change in waveheight, 1-8 November 2001

- Predominantly 12-15*s* swell arriving from northwest
- Significant wave height 0.8-1.3*m*
- Best-fit frequency spread: γ=3.3
- Best-fit directional spread: σ=7.5 deg.

Variability of Nearshore Wavefield: 1-8 November 2001



Potential error using buoy data directional discretization: max. variation ~7%



Potential error using forecast model directional discretization: max. variation ~ 15%

Conclusions

- Errors/uncertainty in estimation of the peak direction of the incident wave spectrum at the NCEX site has the largest impact in nearshore wavefield
- Uncertainty in peak direction likely due to directional discretization
- Errors in directional spread not as significant – differences in directional estimation techniques may have little effect
- Coarse discretization of forecast models problematic – might be alleviated by use of propagation-only model to transform swell from generation area